Hydrological Sciences Journal 2013 vol.58 N1, pages 237-248

Pseudo-hysteretic double-front hiatus-stage soil water parcels supplying a plant-root continuum: The Green-Ampt-Youngs model revisited | Masses d'eau du sol à double front et pseudo-hystérésis alimentant le continuum plante-racines: Retour sur le modèle de Green-Ampt-Youngs

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Abstract

A tension-saturated water slug descends through a homogenous soil after a rainfall (irrigation) event and shrinks due to transpiration by a distributed root-sink and evaporation. The upper (drainage) and lower (imbibition) sharp fronts of the slug separate it from the superjacent and subjacent vadose zones, where water is immobile. In the slug, the hydraulic conductivity is constant according to the Green-Ampt model. The capillary pressures as well as effective porosities on the fronts are given (generally, different) constants that can be viewed as a kind of hysteresis. A volumetric sink models mild (no desaturation of the slug) soil water withdrawal by the plant roots. The sink intensity varies with the depth from the soil surface and with time. Mathematically, the hydraulic head is immediately expressed by double integration of a governing 1-D flow equation. The pressure and kinematic conditions on the fronts result in a Cauchy problem for a system of two ODEs, which is solved by computer algebra routines.

http://dx.doi.org/10.1080/02626667.2012.743028

Keywords

drainage-imbibition, ecohydrology, evapotranspiration, infiltration, root water uptake, two-front Green-Ampt approximation